ZooKeys 29: 13–33 (2009)
doi: 10.3897/zookeys.29.223
www.pensoftonline.net/zookeys

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

Nymphs of some Nearctic leafhoppers (Homoptera, Cicadellidae) with description of a new tribe

Dmitry A. Dmitriev

Illinois Natural History Survey, Institute of Natural Resource Sustainability at the University of Illinois at Urbana-Champaign, Champaign, Illinois, USA

Corresponding author: *Dmitry A. Dmitriev* (dmitriev@inhs.uiuc.edu)

Academic editor: *Michael Wilson* | Received 16 July 2009 | Accepted 8 December 2009 | Published 11 December 2009

Citation: Dmitriev DA (2009) Nymphs of some Nearctic leafhoppers (Homoptera, Cicadellidae) with description of a new tribe. ZooKeys 29: 13–33. doi: 10.3897/zookeys.29.223

Abstract

Last (fifth) instar nymphs of several Nearctic leafhoppers (Cicadellidae) are described in detail for the first time. The nymphs represent subfamilies Neocoelidiinae and Deltocephalinae, and deltocephaline tribes Acinopterini, Cochlorhinini, and Athysanini. The tribe Pendarini, apparently endemic to the New World, is described as new, with the genus *Pendarus* as its type. Besides the type genus, the genera *Dorydiella* and *Paraphlepsius* are included in the new tribe. A preliminary key for nymphs of the Nearctic tribes of Deltocephalinae is provided.

Keywords

Hemiptera, Auchenorrhyncha, nymphs, Deltocephalinae, Neocoelidiinae, identification key

Introduction

Nymphs of many Nearctic leafhopper species were previously described and illustrated by Osborn and Ball (1898d, 1898e, 1898f), Osborn (1915, 1928, 1932), DeLong (1916, 1948), and Oman (1949), but these authors provided only very brief descriptions or illustrations, which are not useful for detailed comparison of the representatives of different groups. Moreover, nymphs of Nearctic leafhoppers have never been used for the description of higher level taxa or for identification keys. This paper emphasizes the nymphal characters important for distinguishing higher level taxa based

Copyright *D.A. Dmitriev*. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

on their nymphs. It continues a series of publications on leafhopper nymphs (Dmitriev 2001, 2002c, 2002d, 2003, 2004a, 2004b, 2006; Dietrich and Dmitriev 2003). The included key is only preliminary and intended to encourage additional research on nymphs of Nearctic leafhoppers and their morphology.

Methods

The nymphs were identified by repeated associations with their adults. Dried and pinned specimens were studied under an Olympus SZX12 microscope with SZX-DA drawing tube attachment. Detailed study was based on examination of specimens cleared in 5% KOH. The key is based only on characters found to be stable across wider taxon sampling, as reflected in the key but whose complete description is beyond the scope of the present study.

The terminology mostly follows Dmitriev (2002c).

Results

Family Cicadellidae

Subfamily Neocoelidiinae Oman, 1949

Description. Nymphs medium sized or large. Body moderately slender. Crown longer than pronotum, as long as wide or longer, elevated above eyes, with angulate anterior margin. Crown-face transition carinate, acrometope distinct; eumetope not reaching dorsum of head. Ocelli at anterior margin of head, close to eyes. Face longer than wide; anteclypeus with slightly convex lateral margins; lorum narrower than anteclypeus, about 1/4 of its inner margin bordered by postclypeus; maxillary plate slightly expanding towards apex; postclypeus longer than wide; lateral margins of gena slightly S-shaped. Antennae long, extending significantly beyond apices of wing pads, attached close to anterior margin of eyes. Pronotum with weak lateral carina. Forewing pads 1.3–1.5 times as long as pterothorax medially. Fore tibia without dorsal rows of macrochaetae, with only two apical setae. Middle tibia with 3 macrochaetae in dorsal rows and 4–6 macrochaetae in ventral rows. Setal formula of hind femur 2+2+1; hind tibia with 8–9 macrochaetae in dorsal rows and intercalary setae among them: 1–3 intercalary setae in anterodorsal row, 1 intercalary seta in posterodorsal row; setae in posteroventral row and intercalary setae in dorsal rows usually very long. First hind tarsomere with pecten of platellae at apex. Abdomen with long macrochaeta at posterolateral corners of each tergite, pygofer with numerous macrochaetae, sometimes macrochaetae slightly flattened. Pygofer with long apical processes usually widely spaced. Male gonapophyses shorter than pygofer, triangular, longer

than wide, with narrowly rounded apices. Usually yellow or pale green, often with reddish or brownish color pattern.

Genus *Neocoelidia* Gillette & Baker, 1895

Description. Body moderately slender. Crown 1.8 times as long as pronotum, two times as long medially as next to eyes, about as long as wide, its anterior margin angulate rounded, posterior margin slightly concave. Crown-face transition carinate. Face slightly longer than wide; anteclypeus with slightly convex lateral margins, 1.1 times as long as wide; lorum 1/2 times as wide as anteclypeus, 1/4 of its inner margin bordered by postclypeus; maxillary plate slightly expanding towards apex; postclypeus longer than wide. Antennae long, extending significantly beyond apices of wing pads. Pronotum 3.3 times as wide as long, with weak lateral carina. Forewing pads 1.3 times as long as pterothorax medially. Setal formula of hind femur 2+2+1; hind tibia with 8 macrochaetae in dorsal rows and shorter intercalary setae among them: 1–3 intercalary setae in anterodorsal row, 1 intercalary seta in posterodorsal row. Apex of first hind tarsomere with pecten of 5 platellae and single regular seta. Abdomen with long macrochaeta at posterolateral corners of each tergite, pygofer with numerous macrochaetae. Pygofer with long apical slightly spaced processes. Male gonapophyses triangular, 1.5 times as long as wide, with narrowly rounded apices.

Neocoelidia tumidifrons Gillette & Baker, 1895 (Fig. 1A, B)

Material. USA, 2 ♀, Illinois, Mason Co., Matanzas Prairie, 31 VII 1997 (Dietrich).

Description. Coloration yellowish white. Inner margins of fore and hind wing pads with black spot at base. Body length 4.6–4.9 mm, head width 1.1 mm.

Notes. *N. tumidifrons* Gillette & Baker, was previously illustrated by Osborn (1928), DeLong (1948), and Oman (1949). Nymphs of *Retrolidia* sp. and several unidentified Neotropical species of Neocoelidiinae were also studied; their characters are incorporated in the tribal description.

Subfamily Deltocephalinae Dallas, 1870

Tribe Acinopterini Oman, 1949

Genus *Acinopterus* Van Duzee, 1892

Description. Body moderately robust. Vertex about as long as pronotum, slightly wider than long; medially about 1.5 times as long as next to eye; anterior margin rounded, posterior margin almost straight. Crown-face transition narrowly rounded;

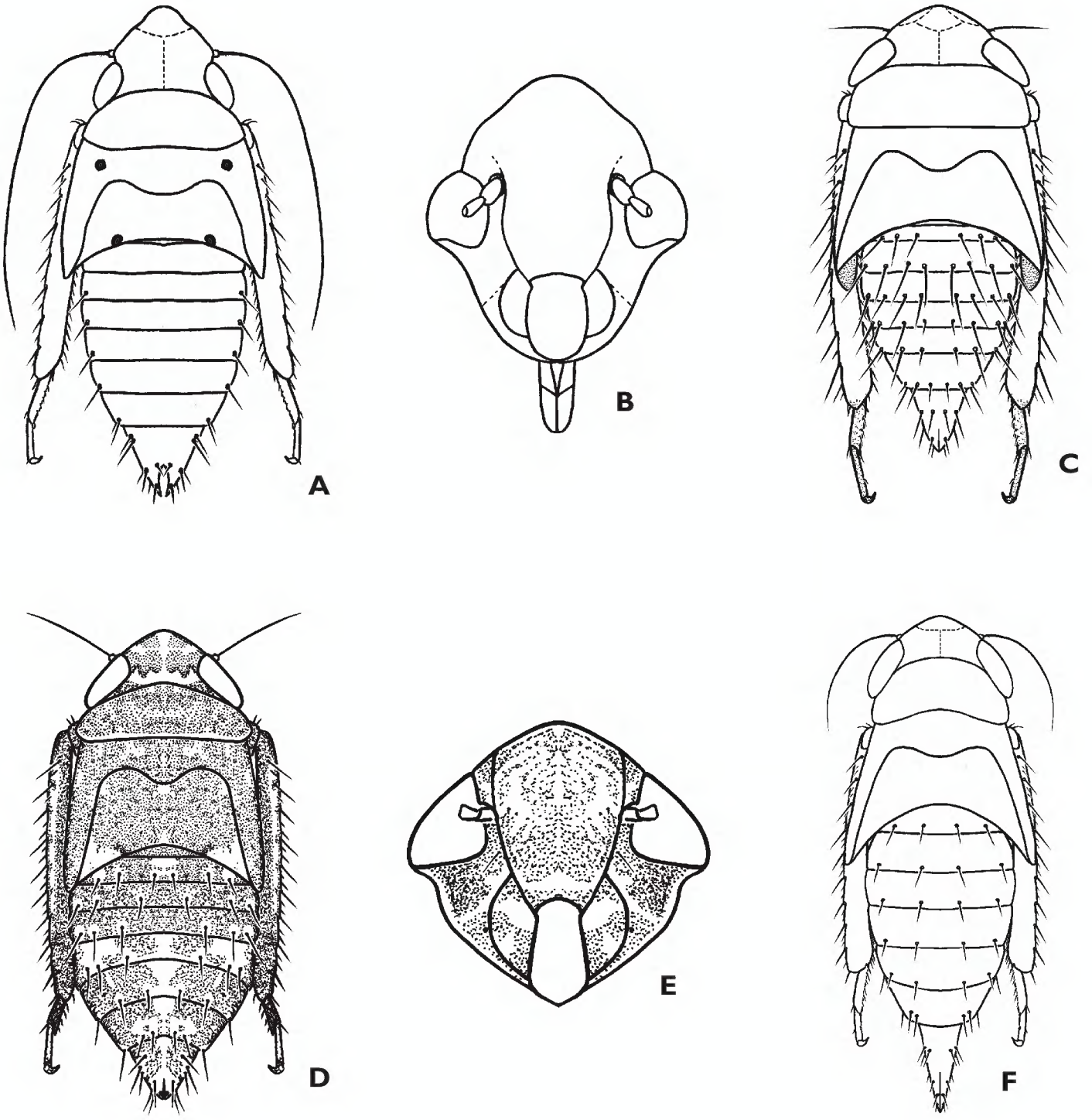

Figure 1. Nymphs of leafhoppers. **A** *Neocoelidia tumidifrons* Gillette & Baker **B** same, face **C** *Acinopterus acuminatus* Van Duzee **D** *Texananus* sp. **E** same, face **F** *Chlorotettix galbanatus* Van Duzee.

acrometope distinct, with remnants of original anterior carina on dorsum of head. Face slightly wider than long; anteclypeus expanding towards apex with contraction at base, about two times as long as wide; lorum about as wide as anteclypeus; postclypeus slightly longer than wide; antenna short, reaching apex of anteclypeus. Pronotum 3.5 times as wide as long, with weak lateral carina. Forewing pads 1.5 times as long as pterothorax medially. Fore tibia with 4 macrochaetae in dorsal rows and numerous setae in ventral rows. Middle tibia with 4 macrochaetae in dorsal rows and 5 macrochaetae in ventral rows. Setal formula of hind femur 2+2+1; hind tibia with 8–9 macrochaetae in dorsal rows; anterodorsal row with 2–4 intercalary setae among macrochaetae; posterodorsal row with 1–2 intercalary setae; apex of hind

tibia with pecten of 7 macrochaetae. First hind tarsomere with pecten of 5 platellae at apex. Abdominal tergites with 6–8 macrochaetae at posterior margins, often with additional shorter macrochaetae at anterior corners. Pygofer about 2 times as long as preceding abdominal tergites. Male gonapophyses triangular, slightly longer than wide, with pointed apices.

Acinopterus acuminatus Van Duzee, 1892 (Fig. 1C)

Material. USA, 2 ♀, Illinois, Hardin Co., Camp Cadiz, 14 VI 1996 (Dietrich); 3 ♂, Texas, 14 mi. S Mineral Worth, 32°38'05" N, 98°04'15" W, prairie, 29 IV 2003 (Dmitriev).

Description. Coloration green, without color pattern. Gonapophyses slightly darkened. Legs with dark setal areolae, apices of hind tibiae may also be darkened. Body length 3.7–3.9 mm; head width 1.3–1.4 mm.

Tribe Athysanini Van Duzee, 1892

Notes. Athysanini is the largest, world wide distributed tribe of Deltocephalinae. The tribe is presently defined based only on the absence of the distinctive features that define other deltocephaline tribes. The genera included in the tribe are so morphologically diverse that it is not possible to separate this assemblage in a single couplet in a key (see the key below). There were few attempts to split Palaearctic genera of Athysanini in up to five subtribes or tribes, namely Athysanina, Platymetopiina, Cicadulina, Alligidiina, and Limotettigini, based on adult (Emeljanov 2009) and nymphal morphology (Dmitriev 2002d, 2006). Similar research should be done for Nearctic region and other parts of the world.

Genus *Texananus* Ball, 1918

Description. Body robust. Crown slightly longer than pronotum, slightly wider than long, medially 1.5 times as long as next to eyes. Crown-face transition narrowly rounded, remnants of anterior carina slightly shifted to dorsum of head. Face about as long as wide; anteclypeus 1.7 times longer than wide, significantly expanding towards apex, with constriction at base; lorum about as wide as anteclypeus, 2/5 of its inner margin bordered by postclypeus; postclypeus longer than wide; antennae of medium length, reaching apices of forewing pads; maxillary plate with sensory pit close to lorum. Pronotum 3.2 times as wide as long. Forewing pads 1.5 times as long as pterothorax medially. Hind femur setal formula 2+2+1. Hind tibia with 9 macrochaetae in dorsal rows. Male gonapophyses triangular, longer than wide, with narrowly rounded apices.

***Texananus* sp.** (Fig. 1D, E)

Material. USA, 1 ♂, Illinois, Hardin Co., Camp Cadiz, 14 VI 1996 (Dietrich).

Description. Coloration brownish, color pattern consists of numerous confluent dark brown specks. Crown with pale sutures and pale posterior margin. Pronotum with pale posterior margin; metanotum with two dark spots at posterior margin; hind wing pad apices pale. Abdomen with pale setal areolae; middle part of tergites and sides of tergites V and VI pale. Femora with dark rings, tibiae with longitudinal stripes, setal areolae dark. Body length 4.3 mm; head width 1.6 mm.

Notes. Nymphs of *Texananus* are morphologically similar to nymphs of *Phlepsius* and may be transferred to the subtribe Platymetopiina.

Genus *Chlorotettix* Van Duzee, 1892

Description. Body slender. Crown about as long as pronotum, 2 times as wide as long, medially 1.5 times as long as next to eye; anterior margin broadly rounded, posterior margin concave. Crown-face transition narrowly rounded. Face wider than long; anteclypeus expanded towards apex, with constriction at base; about 2 times as long as wide. Lorum about as wide as anteclypeus, 2/5 of its inner margin bordered by postclypeus. Postclypeus 1.5 times longer than wide. Lateral margin of gena almost straight. Antenna long, almost reaching forewing apex. Pronotum 3 times as wide as long, without lateral carina. Forewing pads 1.6 times as long as pterothorax medially. Fore tibia with 4 macrochaetae in dorsal rows. Middle tibia with 5 macrochaetae in each longitudinal row. Setal formula of hind femur 2+2+1. Hind tibia with 9 macrochaetae in dorsal rows and shorter intercalary setae among them: 2–4 in anterodorsal row and 1 in posterodorsal row; apex of tibia with pecten of 7 macrochaetae. First hind tarsomere with pecten of 5 platellae and one regular macrochaeta at apex. Abdomen with 4 longitudinal rows of macrochaetae; tergites VII and VIII with 6 macrochaetae; macrochaetae about as long as half length of tergites. Pygofer more than 2 times as long as preceding abdominal tergites. Male gonapophyses longer than wide with narrowly rounded apices.

***Chlorotettix galbanatus* Van Duzee, 1892** (Fig. 1F)

Material. USA, 1 ♀, Illinois, Hardin Co., Camp Cadiz, 14 VI 1996 (Ch. Dietrich); 1 ♂, 2 ♀, Illinois, Calumet, 41°41'48" N, 87°34'22" W, 3 IX 2003 (Dmitriev).

Description. Coloration yellowish green without color pattern. Body length 5.2–5.9 mm; head width 1.4 mm.

Notes. An unidentified nymph of *Chlorotettix* from Argentina has two brown broad longitudinal stripes with washed out lateral margins; macrochaetae on abdomen and legs dark, with dark setal areolae. The nymph of *Ch. meriscus* Cwikla was illustrated by Cwikla (1988). The tribal placement of the genus *Chlorotettix* requires further

investigation. The nymphs of this genus have a long pygofer, which is not characteristic for the tribe Athysanini. *Chlorotettix* shares some characters with the new tribe Pendarini (long pygofer), although the former has the crown-face transition rounded, longer abdominal macrochaetae and different color pattern.

Genus *Scaphoideus* Uhler, 1889

Description. Body slender. Crown 1.5 times as long as pronotum, 1.3 times longer than wide, medially almost 2 times as long as next to eye; its anterior margin acute-angled, posterior margin straight. Crown-face transition carinate; acrometope distinct, with remnants of the original anterior carina on dorsum of head. Face about as long as wide; anteclypeus expanded towards apex; 1.7 times as long as wide; lorum as wide as anteclypeus, 2/5 of its inner margin bordered by postclypeus; postclypeus about 2 times as long as wide. Gena evenly convex, slightly incised below eye. Antennae long, extending beyond apices of wing pads. Pronotum 3 times as wide as long, without lateral carina. Forewing pads 1.4 times as long as pterothorax medially. Fore tibia with 4 macrochaetae in dorsal rows and numerous setae in ventral rows. Middle tibia with 4 macrochaetae in all longitudinal rows. Setal formula of hind femur 2+2+1; hind tibia with 8 macrochaetae in dorsal rows and shorter intercalary setae among them: 4–5 in anterodorsal row and 1 in posterodorsal row. Abdomen with 4 longitudinal rows of macrochaetae; tergites VII and VIII with 6 macrochaetae; macrochaetae longer than length of tergites. Pygofer about 2 times as long as preceding tergites. Male gonapophyses triangular, almost 2 times longer than wide, with pointed apices.

Scaphoideus cinerosus Osborn, 1900 (Fig. 2A)

Material. USA, 2 ♂, Illinois, Vermilion Co., 1.7mi S Muncie, 40°05'27" N, 87°50'11" W, 20 VI 2001 (Dietrich).

Description. Coloration pale brownish with brown color pattern. Crown pale with dark median longitudinal stripe divided into two parts by pale median line and broken by pale ecdysial line; with small spots laterally in front of eyes. Notum and abdomen with two stripes with ragged inner edges, these stripes fused together on abdominal tergite VII and at posterior margin of tergite VIII; lateral margins of abdominal tergites pale; tergites III–VI with large pale patch medially; setal areolae pale. Pronotum, mesonotum, and abdomen with narrow median stripe divided medially by pale median line. Pygofer with two large black spots laterally. Venter pale; apex of first hind tarsomere darkened. Body length 3.2–3.3 mm; head width 0.9 mm.

Notes. Nymphs of *Scaphoideus titanus* Ball, *S. immistus* (Say), and *S. major* Osborn were illustrated by Barnett (1977), and the nymph of *S. luteolus* Van Duzee was illustrated by Oman (1949). Oman (1943) placed *Scaphoideus* and several related genera in the tribe Scaphoideini, but never validated this tribe providing a formal description.

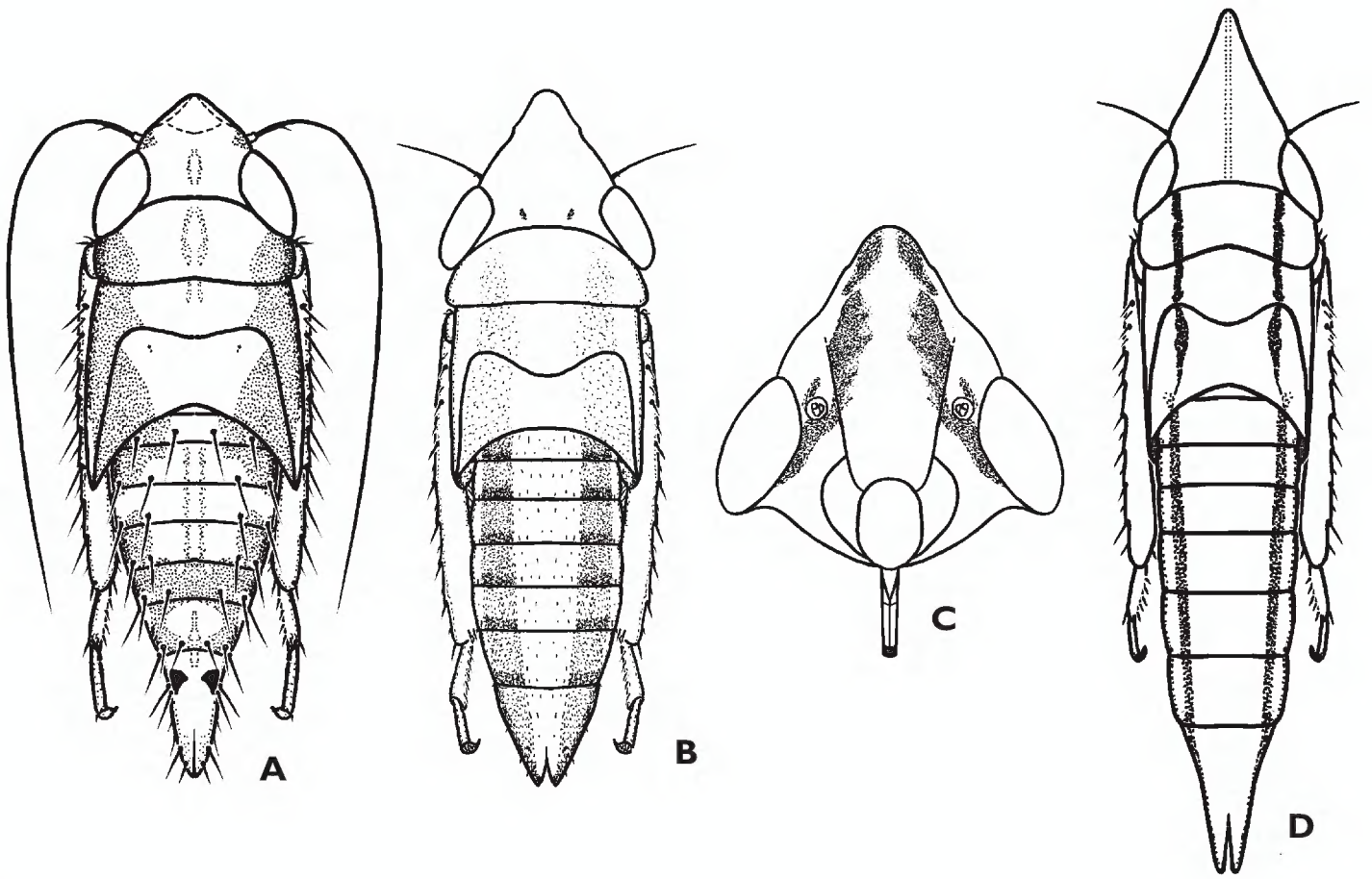

Figure 2. Nymphs of leafhoppers. **A** *Scaphoideus cinerosus* Osborn **B** *Cochlorhinus pluto* Uhler **C** same, face **D** *Huleria quadripunctata* Ball.

The group is considered *nomen nudum* (see Zahniser and Dietrich in press for details). The nymphs of Scaphoideini are very similar to the nymphs of Platymetopiina (Athysanini), another poorly defined group recognized by some researchers (see Emeljanov 1999; Dmitriev 2006), but usually treated as a synonym of Athysanini (Zahniser and Dietrich in press). They have similar body proportions, chaetotaxy, and color pattern. The only difference found so far is longer macrochaetae in the posterodorsal row of the hind tibia; these are usually much longer than macrochaetae in the anterodorsal row. Further investigation is needed to evaluate the status of Scaphoideini.

Tribe Cochlorhinini Oman, 1949

Description. Body slender. Head long; crown 2–3 times as long as pronotum, longer than wide, apex narrowly rounded, posterior margin slightly concave. Crown-face transition carinate; acrometope distinct. Face as long as wide or longer; anteclypeus parallel sided, 1.5–1.7 times as long as wide; lorum about as wide as anteclypeus, 1/2 of its inner margin bordered by postclypeus; postclypeus elongated, sometimes with faint median longitudinal carina in dorsal half. Gena with single hair like seta, its lateral margin slightly S-curved or straight. Antenna short, slightly extended beyond anteclypeus apex. Pronotum 3–3.5 times as wide as long, with lateral carina. Forewing pads 1.5 times as long as pterothorax medially. Fore tibia with 4 longitudinal rows of

macrochaetae: anteroventral row with numerous setae, increasing in size towards apex of tibia; anterodorsal, posterodorsal, and posteroventral rows with 4–5 macrochaetae each. Middle tibia with 4–5 macrochaetae in dorsal rows and 5–6 macrochaetae in ventral rows. Setal formula of hind femur 2+2+1. Hind tibia with 7–9 macrochaetae in dorsal rows, and 1–3 intercalary setae among them, with pecten of setae at apex (setae II–IV are platellae, other setae regular). First hind tarsomere with platellae in anteroventral row and in distal pecten; one platella on the border between second and third tarsomere. Entire body covered with short setae. Pygofer 1.5–2 times as long as preceding tergites. Male gonapophyses triangular, about as long as wide, with narrowly rounded apices. Coloration yellowish, usually with two longitudinal stripes.

Genus *Cochlorhinus* Uhler, 1876

Description. Body slender. Crown 2 times as long as pronotum, slightly longer than wide. Face about as long as wide; anteclypeus parallel sided, 1.7 times as long as wide; lorum about as wide as anteclypeus; postclypeus ~1.8 times as long as wide; lateral margin of gena slightly S-shaped. Pronotum 3.5 times as wide as long, with lateral carina. Forewing pads 1.5 as long as pterothorax medially. Hind tibiae with 7 macrochaetae in dorsal rows and 2–3 shorter intercalary setae between macrochaetae. Entire body covered with short setae; setae slightly enlarged at hind margin of tergite VIII and on pygofer. Male gonapophyses triangular, about as long as wide, apices narrowly rounded.

Cochlorhinus pluto Uhler, 1876 (Fig. 2B, C)

Material. USA, 2 ♂, 3 ♀, California, Monterey Co., rt. 101 exit San Ardo, 5 V 1998 (Rakitov); 1 ♂, California, Rt. 74, 4 mi. E of Hemet, 33.71111° N, 116.77822° W, 2169 ft., 25 V 2002 (Zahniser).

Description. Coloration dirty yellow with brownish color pattern. Crown with pair of small oval spots at posterior margin. Notum and abdomen with two broad longitudinal stripes, which brighter on abdomen; pale median stripe about as wide as dark stripes; lateral margins of tergites pale. Venter pale, laterotergites slightly darkened. Face pale with dark brown color pattern; two stripes pass from top of face to antennal pits, stripes broken with pale epistomal suture; small spots above antennal pits. Antenna with dark ring on pedicel. Proepimeron with dark longitudinal stripe. Body length 4.1–4.9 mm; head width 1.3–1.4 mm.

Genus *Huleria* Ball, 1902

Description. Body slender. Head strongly elongated; crown almost 3 times as long as pronotum, 1.8 times as long as wide. Face longer than wide, with faint median longi-

tudinal carina in dorsal half; anteclypeus 1.5 times as long as wide, its lateral margins slightly convex; lorum about as wide as anteclypeus; postclypeus strongly elongated; lateral margin of gena almost straight. Pronotum 3 times as wide as long, with weak lateral carina. Forewing pads 1.5 times as long as pterothorax medially. Hind tibia with 8–9 macrochaetae in dorsal rows and 1–3 shorter intercalary setae among them. Abdomen without macrochaetae. Pygofer 2 times as long as preceding tergites, with short setae along ventral margin.

Huleria quadripunctata Ball, 1902 (Fig. 2D)

Material. USA, 2 ♀, California, San Bernardino, Waterman Canyon, 9 V 1988 (D. Kasparyan) ; 1 ♀, California, Rt. 74, 4 mi. E of Hemet, 33.71111° N, 116.77822° W, 2169 ft., 25 V 2002 (Zahniser).

Description. Coloration straw yellow, with two dark brown narrow lateral stripes on notum and abdomen. Face with narrow longitudinal brown stripes from tip of face to eyes and continued below eyes on genae. Proepimeron with dark longitudinal stripe. Sternites pale, ventral laterotergites brownish. Body length 7.9–8.4 mm; head width 1.5–1.6 mm.

Tribe Pendarini trib. n.

Type genus. *Pendarus* Ball, 1897
Included genera. Type genus, *Dorydiella* Baker, *Paraphlepsius* Baker.

Description. Nymphs. Body medium sized or large, robust, rarely slender. Crown as long as pronotum or longer; transition to face carinate; acrometope distinct, its anterior margin tracing anterior carina. Face often with distinct longitudinal carina in upper part; anteclypeus 1.5–1.7 times as long as wide, weakly expanding towards apex; lorum about as wide as anteclypeus; 2/5 of its inner margin bordered by postclypeus; postclypeus elongated; gena with evenly convex lateral margin, with incision below eye; maxillary sensorial pits positioned close to lorum, near middle level of its lateral margin. Antenna short, not reaching apex of anteclypeus. Pronotum 2.5–3 times as wide as long, its lateral margin short, with well developed lateral carina. Forewing pads 1.5 times as long as pterothorax medially. Fore and middle tibiae with 4–7 macrochaetae in dorsal rows. Setal formula of hind femur 2+2+1, 2+2+1+1, or 2+1+1; hind tibia with 8–11 macrochaetae in dorsal rows and shorter intercalary setae among them: 1–5 intercalary setae in anterodorsal row and 1–2 setae in posterodorsal row. Apex of first hind tarsomere with 5–6 platellae and single regular seta. Abdomen with 4–6 longitudinal rows of very short macrochaetae; entire body covered with shorter setae, almost as long as macrochaetae in longitudinal rows. Pygofer strongly elongated. Male gonapophyses triangular, slightly longer

than wide, apices narrowly rounded. First segment of anal tube with pointed apical projection.

Adults. Body medium sized or large, robust. Head usually as wide as pronotum, or slightly wider; crown not longer than wide, usually several times wider, than long, its anterior margin broadly rounded or angulate produced; transition to face carinate or narrowly rounded. Ocelli at anterior margin of head close to eyes. Face flat or weakly concave or convex, variable in shape; postclypeus as long as wide or longer; anteclypeus parallel sided or weakly expending towards apex, shape of lorum and gena as in nymphs. Antenna short. Pronotum with strongly convex anterior margin and shallowly concave posterior margin. Leg chaetotaxy as in nymphs. Macropterous; wing venation usual for Deltocephalinae. Coloration yellowish or brownish; without color pattern or mottled and streaked with dark brown; face usually without traces of muscle attachment; forewing usually marked with numerous ramose pigment lines. Male pygofer usually strongly extended; apex usually acute and often bearing one or more spines or teeth, often with dorsal or distal macrochaetae. Anal tube with pointed distal projection. Style variable in shape, short, broadly bilobed basally. Aedeagus variable in shape, with single gonopore; paraphyses, if present, fused to aedeagal shaft, often with single or paired apical and/or preapical processes. Connective Y-shaped, with stem shorter than arms. Valve triangular. Genital plates together triangular, with pointed or narrowly rounded apices; lateral margin straight, convex, or concave, usually with uniseriate macrochaetae. Seventh sternite in female variable in shape; ovipositor slightly extended beyond pygofer apex.

Diagnosis. The nymphs of Pendarini differ from the representatives of other tribes of Deltocephalinae as follows: carinate crown-face transition; face with a medial longitudinal carina in upper part; acrometope with its anterior margin tracing the anterior carina of the head; abdomen with 4–6 longitudinal rows of very short macrochaetae; pygofer elongated.

The following combination of characters may be used to distinguish the adults of the new tribe: forewing marked with numerous ramose pigment lines, male pygofer apex acute and usually bearing one or more spines or teeth, aedeagal shaft usually with one or more distal processes and frequently with paired preapical processes, with one gonopore.

Notes. The genera included in the new tribe Pendarini were previously placed in Athysanini, a polyphyletic assemblage of genera (Zahniser and Dietrich in press). Adults of these species are indeed very similar to adults of some species of Athysanini (see Hamilton 1975). The most distinctive characters separating species of Pendarini from Athysanini, as previously mentioned by Oman (1949), are found in the nymphs. This situation is very similar to some other tribes of Deltocephalinae (e.g. Limotettigini and Drabescini) which are very purely defined based on adult characters, but distinct based on nymphal morphology (see Dmitriev 2002d, 2004a, and the key for identification of tribes of Deltocephalinae below). Based on the set of nymphal features, the new tribe is apparently closely related to Scaphytopiini and Hecalini, especially to its more primitive subtribe Glossocratina. From Scaphytopiini, representatives of the new tribe

may be distinguished by the more robust body, smaller genae, short antennae, short abdominal macrochaetae, and different color pattern; from Hecalini, Pendarini may be distinguished by the shorter lateral margin of the pronotum, and the long pygofer.

Recent phylogenetic analysis (Zahniser and Dietrich in press) based on morphological and molecular data recovered *Dorydiella* and *Paraphlepsius* as monophyletic, *Pendarus* was not included in that study, but this genus is very closely related to *Paraphlepsius* and was treated as a synonym or a subgenus of the latter by some previous researchers (see Hamilton 1975 for details). Further investigation may reveal some other genera presently included in Athysanini, which may be transferred to Pendarini.

Preliminary key for identification of nymphs of the genera of Pendarini

1. Head strongly elongated (4.6–5 times as long as pronotum) (Fig. 3A–C)..... ***Dorydiella***
1'. Head shorter (1–2.5 times as long as pronotum) (Fig. 3D, F) **2**
2. Pygofer 5 times as long as preceding abdominal tergites (Fig. 3D) ..... ***Pendarus***
2'. Pygofer about 2 times as long as preceding abdominal tergites (Fig. 3F)..... ***Paraphlepsius***

Genus *Dorydiella* Baker, 1897

Description. Body slender. Head strongly elongated; crown 4.6–5 times as long as pronotum, about 2.5 times as long as wide, with broadly rounded apex, lateral margins of projection slightly concave. Crown-face transition carinate, with lateral margins slightly up lifted. Face considerably longer than wide, with sharp median carina; postclypeus elongated, epistomal suture not visible. Pronotum 2.5 times as wide as long. Setal formula of hind femur 2+1+1. First hind tarsomere with pecten of 6 platellae and single regular seta at apex. Abdomen with 6 rows of very short macrochaetae.

Dorydiella floridana Baker, 1897 (Fig. 3A–C)

Material. USA: 3 ♂, 1 l_4, Illinois, Princeton, 2–7 VII 1934–1936 (DeLong & Ross, Burks); 2 ♂, Illinois, Shawneetown, 27 VII 1936 (DeLong & Mohr), 1 ♂, Illinois, Zion, 25 VII 1934 (Frison & DeLong).

Description. Coloration brownish, entire body covered with numerous dark specks. Two narrow brown stripes along pale median line. Abdomen with pale setal areolae, with dark spots mediad of lateral setae; lateral margins of tergites dark brown. Venter dark brown, face with numerous confluent dark specks, edge of longitudinal carina pale, apex of face with pale and dark spots. Body length 8.3–8.7 mm; head width 1.5–1.6 mm.

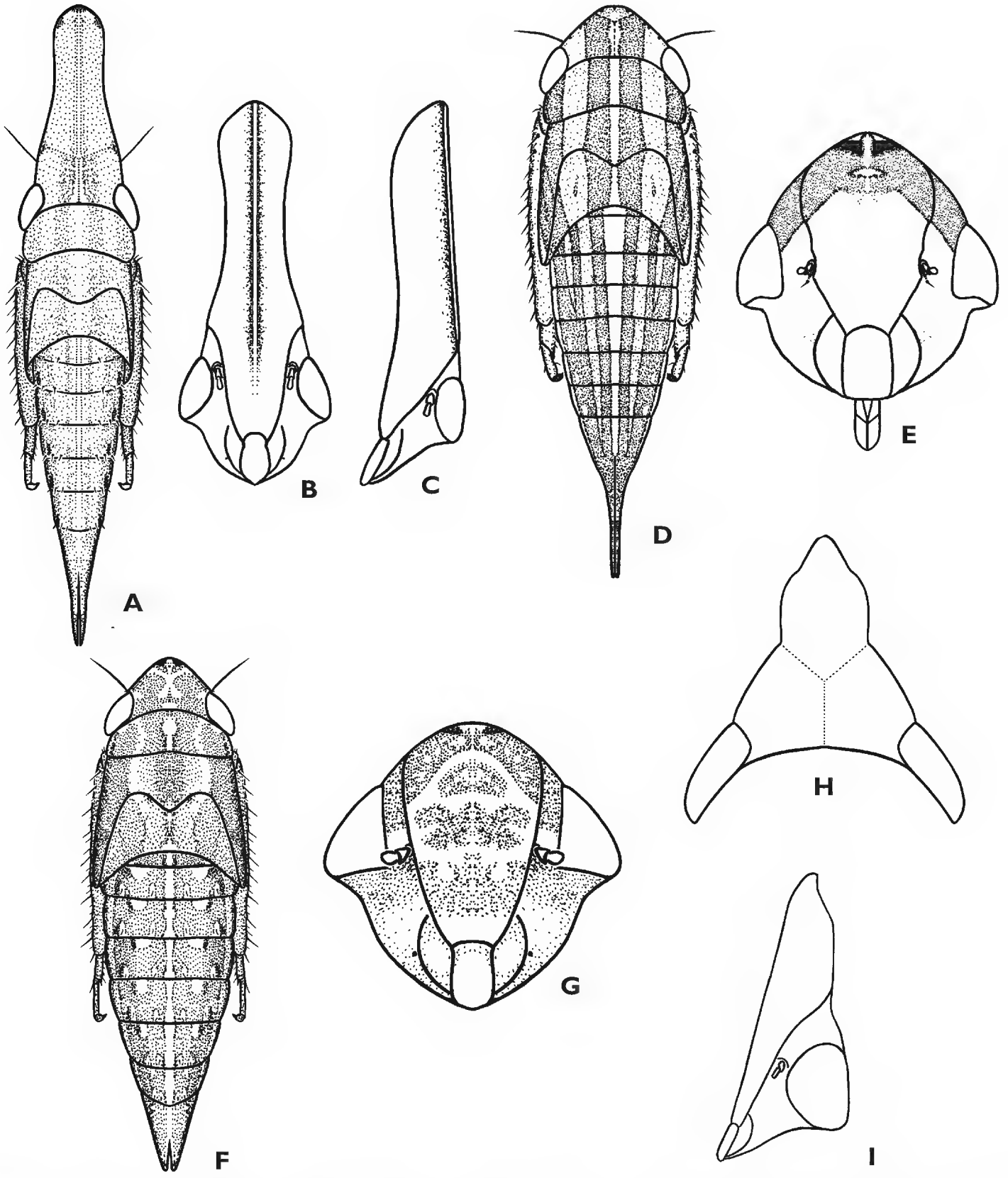

Figure 3. Nymphs of leafhoppers. **A** *Dorydiella floridana* Baker **B** same, face **C** same, head, lateral view **D** *Pendarus magnus* (Osborn & Ball) **E** same, face **F** *Paraphlepsius* sp. 1 **G** same, face **H** *Paraphlepsius* sp. 2 **I** same, face.

Genus *Pendarus* Ball, 1927

Description. Body moderately slender. Crown about as long as pronotum, 2 times as wide as long, medially about 2 times as long as next to eye; anterior margin obtuse angulate rounded, posterior margin concave. Face slightly wider than long; with weak median carina in upper part. Pronotum 3.2 times as wide as long. Fore tibiae with 7 macrochaetae in dorsal rows, ventral rows with numerous setae, their size increases

towards apex of tibia. Middle tibiae with 7–8 macrochaetae in 4 longitudinal rows. Setal formula of hind femur 2+2+1+1; hind tibia with 10–11 macrochaetae in dorsal rows and shorter intercalary setae among them. First hind tarsomere with pecten of 5 platellae at apex; boundary of segments II and III with 2 platellae. Abdomen with 4 longitudinal rows of very short setae. Pygofer 5 times as long as preceding tergites, without macrochaetae.

Pendarus magnus (Osborn & Ball, 1897) (Fig. 3D, E)

Athysanus magnus Osborn & Ball, 1897
Euscelis magnus Van Duzee, 1916
Remadosus magnus Ball, 1929
Pendarus (*Remadosus*) *magnus* Hamilton, 1975

Material. USA, 1 ♂, 2 ♀, 1 l_4, Illinois, Iroquois Co., Loda Cemetery Prairie, 40°31' N, 88°05' W, 6 VIII 1997 (Dietrich).

Description. Brownish, with 4 dark brown longitudinal stripes; lateral stripes about twice as wide as median; abdomen with pale setal areolae and pale lateral margins of tergites. Venter paler than dorsum. Face mostly pale, postfrons darker, blackened at apex, clypeus often with darkened longitudinal stripe. Body length 8–8.5 mm; head width 2.3 mm.

Notes. The nymph of *P. magnus* (Osborn & Ball) was illustrated by Oman (1949).

Genus *Paraphlepsius* Baker, 1897

Description. Body moderately robust. Crown as long as pronotum or longer, rounded or angulate at apex. Face with median longitudinal carina in upper part; boundaries of postclypeus, frons and postfrons definitely marked with color pattern. Pronotum 3 times as wide as long. Hind femur setal formula 2+2+1. Hind first tarsomere with pecten of 5 platellae and single regular seta. Abdomen with 4 longitudinal rows of very short setae.

Paraphlepsius spp. (Fig. 3F–I)

Description. Coloration brownish, color pattern consists of numerous dark brown specks; two longitudinal pale stripes in anterior part of body; abdomen with pale stripes near sides of tergites. Abdomen with pale longitudinally expanded setal areolae, lateral areolae with darkened margins; dark spots between median and lateral rows of setae near anterior margins of tergites. Head with two dark spots at apex. Face largely dark, with broad pale stripes along sutures. Legs with dark setal areolae.

Notes. Nymphs of 3 unidentified species from Illinois (USA) were studied. Nymphs of *P. altus* (Osborn & Ball) were illustrated by Osborn and Ball (1898f), *P. nebulosus* (Van Duzee) by Osborn and Ball (1898f) and Osborn (1928), and *P. irroratus* (Say) by Osborn (1928, 1932).

The preliminary key to tribes of immature Nearctic Deltocephalinae includes both native and introduced groups. An interactive key to tribes and subfamilies of Cicadellidae is also available from the web site (see Dmitriev 2003 onward).

Preliminary key to Nearctic tribes of Deltocephalinae based on fifth instar nymphs

1. Crown-face transition carinate (Fig. 1A, F, 3A) **2**
1'. Crown-face transition rounded or secondary flattened, with traces of original carina visible dorsally at anterolateral margins of acrometope (Fig. 2C, 4A).....**9**
2. Abdomen with longitudinal rows of macrochaetae (Fig. 2A) **3**
2'. Abdomen without macrochaetae, or with macrochaetae on last two tergites and pygofer only (Fig. 2B) **6**
3(2). Abdomen with two lateral longitudinal rows of macrochaetae, tergites VII and VIII with additional macrochaetae in posterolateral corners. Nymphs green. (Introduced to Nearctic).....**Fieberiellini**
3'. Abdomen with 4–6 longitudinal rows of macrochaetae throughout tergites III–VIII. (Fig. 1D, F). Nymphs of any color..... **4**
4(3). Pygofer only 1.5 times as long as preceding tergites (Fig. 2B). Face without median longitudinal carina. Crown as long as or usually longer than wide. Hind femur setal formula 2+1..... **Stenometopiini**
4'. Pygofer 2 times as long as preceding tergites or longer (Fig. 3A). Face usually with median longitudinal carina in upper part (Fig. 3B, C). Shape of crown variable. Hind femur setal formula variable..... **5**
5(4). Abdomen with very short macrochaetae (about 1/5 as long as tergite length) (Fig. 3A) ..... **Pendarini trib. n.**
5'. Abdomen with long macrochaetae (about as long as or longer than length of tergites) (Fig. 2A).....**Scaphytopiini**
6 (2). Hind tibia with platellae in distal pecten (Fig. 4D) 7
6'. Hind tibia only with regular macrochaetae in distal pecten (Fig. 4E, F) **8**
7(6). Anteclypeus tapering towards apex, strongly produced beyond maxillary plates (Fig. 4B). Forewing pads about 1.2 times as long as pterothorax medially. Hind femur setal formula 2+1. Brownish. (On *Pinus*).....
.....Koebeliini: **Koebeliina**
7'. Anteclypeus parallel-sided or expanded towards apex, only slightly produced beyond maxillary plates (Fig. 2C). Forewing pads about 1.5 times as long as pterothorax medially. Hind femur setal formula 2+2+1. Yellowish, usually with two brown longitudinal stripes. (On grasses, mimic seeds)..... **Cochlorhinini**

8(6). Crown bend along median line. Pronotum with longitudinal carina. Abdomen without macrochaetae. Body strongly elongate ..... **Dorycephalini**

8'. Crown flat. Pronotum without longitudinal carina. Abdominal tergite VII with two macrochaetae at posterolateral corners and tergite VIII with 4 macrochaetae. Body not strongly elongate ..... **Hecalini**

9(1). Apex of hind tibia with platellae (Fig. 4D) ..... Macrostelini: **Balcluthina**

9'. Apex of hind tibia with regular macrochaetae only (Fig. 4E, F) **10**

10(9). First hind tarsomere with platellae in ventral rows (Fig. 4D, E). Head usually significantly broader than pronotum **11**

10'. First hind tarsomere only with regular setae in ventral rows (Fig. 4F). Head usually not or only slightly broader than pronotum **12**

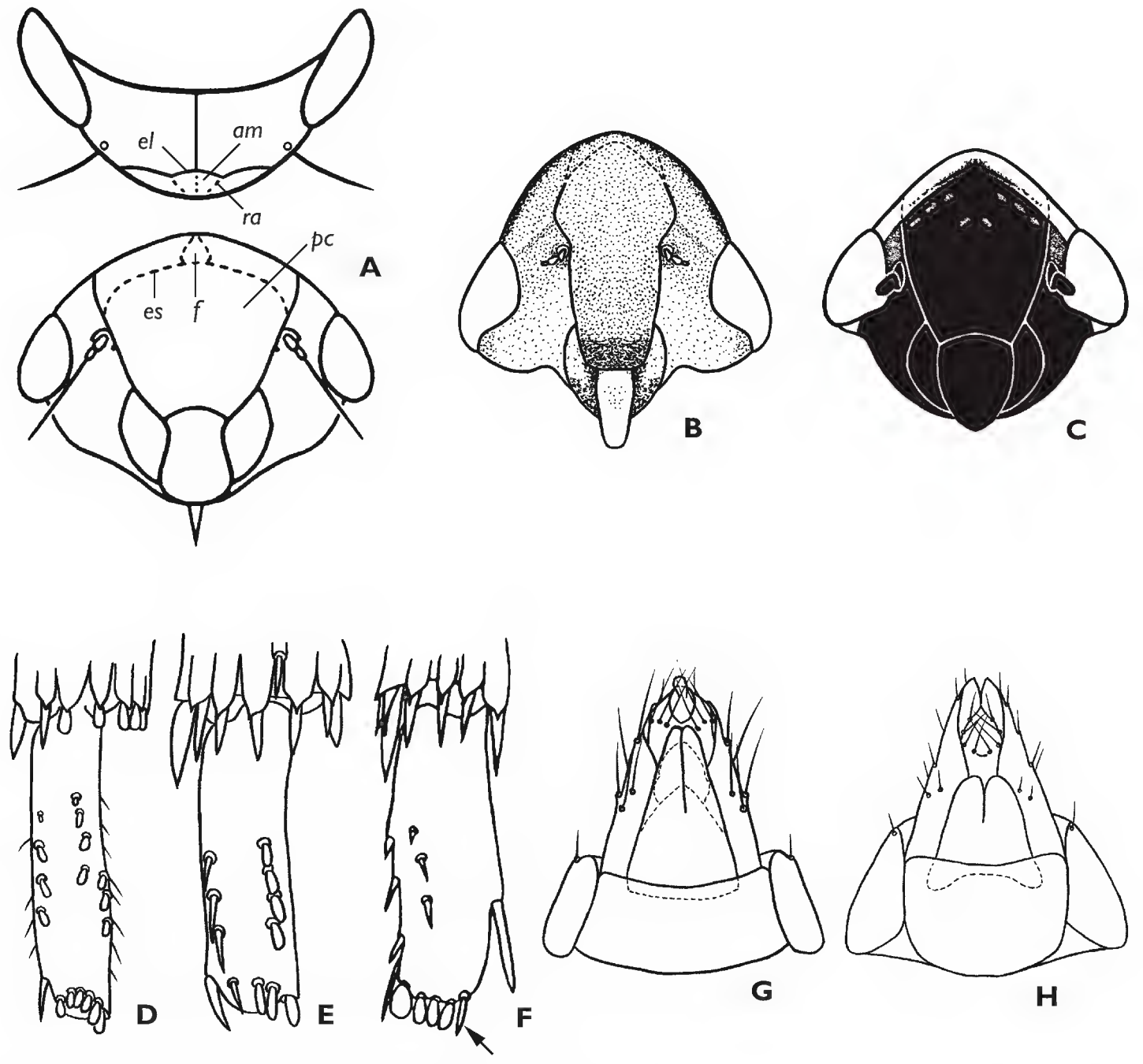

Figure 4. Characters used in the key. **A** general head structure (abbreviations: *am* acrometope *el* ecdysial line *es* epistomal suture *f* frons *pc* postclypeus *ra* remnants of anterior carina) **B–C** face **B** *Koebelia grossa* Ball **C** *Diplocolenus abdominalis* (F.) **D–F** apices of the hind tibiae and the first hind tarsomere **D** *Koebelia californica* Baker **E** *Opsius pallasi* Leth. **F** *Deltocephalus pulicaris* Fall. (arrow points to the anterior seta in distal pecten of hind tarsomere) **G–H** apex of male abdomen **G** *Macrosteles laevis* (Rib.) **H** *Doratura stylata* (Boh.).

11(10). Anteclypeus tapering towards apex, strongly produced beyond maxillary plates (Fig. 4B). Abdomen with macrochaetae on last tergites only. (On *Pinus sylvestris*, introduced to Nearctic).....Koebeliini: **Grypotina**

11'. Anteclypeus parallel-sided, only slightly produced beyond maxillary plates (Fig. 2C). Abdomen with 4 longitudinal rows of very short macrochaetae usually placed on small tubercles. (Introduced to Nearctic).....Opsiini: **Opsiina**

12(10). Abdomen without macrochaetae, or with macrochaetae on pygofer only. Body very broad, usually only about 1.5 times as long as wide..**Penthimiini**

12'. Abdomen with longitudinal rows of macrochaetae, or with macrochaetae at least on tergite VIII. Body more than 1.5 times as long as wide..... **13**

13(12). Abdomen with 8 or more longitudinal rows of macrochaetae or with macrochaetae on last tergites only..... **14**

13'. Abdomen with 2–6 longitudinal rows of macrochaetae..... **19**

14(13). Abdomen with macrochaetae on tergites VII, VIII and pygofer only..... **15**

14'. Abdomen with numerous longitudinal rows of macrochaetae throughout tergites III–VIII and pygofer..... **18**

15(14). Crown about as long as wide or longer..... **Chiasmini**, part

15'. Crown distinctly wider than long..... **16**

16(15). Abdomen with macrochaetae on tergites VII and VIII. Forewing pads 1.5–2 times as long as pterothorax medially. Male gonapophyses significantly longer than wide (Fig. 4G). Epistomal suture more distinct than anterior border of acrometope.....Macrostelini: **Macrostelina**

16'. Abdomen usually with macrochaetae on tergite VIII only. Forewing pads 1–1.5 times as long as pterothorax medially. Male gonapophyses about as long as wide (Fig. 4H). Epistomal suture usually indistinct, anterior border of acrometope usually visible..... **17**

17(16). AD row of hind tibia with 6–7 macrochaetae. Coloration black and shiny or brownish with large black spots at upper part of face .....**Limotettigini**

17'. AD row of hind tibia with 8 macrochaetae. Coloration variable; face without large black spots at upper part of face.....**Athysanini**, part

18(14). Abdomen with macrochaetae at anterolateral corners of tergites in addition to 8 macrochaetae at hind margin. Pygofer about 2 times as long as preceding tergites. Greenish. (Fig. 1C) .....**Acinopterini**

18'. Abdomen without macrochaetae at anterolateral corners of tergites. Pygofer about 1.5 times as long as preceding tergites. Coloration variable.....**Athysanini**, part

19(13). Abdomen with 2 longitudinal rows of macrochaetae (usually with some additional macrochaetae on last segments)..... **20**

19'. Abdomen with 4–6 longitudinal rows of macrochaetae..... **21**

20(19). Abdominal tergites V–VIII with macrochaetae at posterolateral corners. Crown wider than long, with rounded anterior margin. Face with black spots in upper part.....Macrostelini: **Macrostelina**, part

20'. Only abdominal tergites VII–VIII with macrochaetae at posterolateral corners. Crown longer than wide, its anterior margin angulate. Face without black spots ..... **Athysanini**, part

21(19). Anterior seta in pecten of first hind tarsomere regular (Fig. 4F). Tergite VII often with 2 or 4 macrochaetae (macrochaetae of middle rows may absent) ..... **Deltocephalini**

21'. Anterior seta in pecten of first hind tarsomere platella, posterior seta or rarely several setae sometimes regular (Fig. 4D, E). Tergite VII with 2–6 macrochaetae **22**

22(21). Abdominal tergite VII with 2–4 macrochaetae **23**

22'. Abdominal tergite VII with 6 macrochaetae **24**

23(22). Anteclypeus parallel sided; about 1/4 of inner margin of lorum bordered by postclypeus. Male gonapophyses about as long as wide (Fig. 4H). (Introduced to Nearctic) ..... Opsiini: **Circuliferina**

23'. Anteclypeus expanded towards apex; about 2/5 of inner margin of lorum bordered by postclypeus (Fig. 4A). Male gonapophyses usually longer than wide (Fig. 4G) ..... **Athysanini**, part

24(22). Antennae long, almost reaching apices of forewing pads or extending beyond them. Body slender or moderately slender. Anterior margin of head angulate **25**

24'. Antennae shorter, not reaching apices of forewing pads. Body variable in shape. Anterior margin of head variable in shape **27**

25(24). Head usually wider than pronotum. Coloration usually consists of longitudinal stripes or transverse bands, anterior margin of head often with black spots ..... Athysanini: **Cicadulina**

25'. Head about as wide as pronotum or pronotum wider. Coloration consists of dark and pale patches, often with black spots on thorax and/or abdomen **26**

26(25). Macrochaetae in PD row of hind tibia usually longer than macrochaetae in AD row ..... **Scaphoideini**, nomen nudum

26'. Macrochaetae in both dorsal rows of hind tibia of about equal length ..... **Athysanini**, part

27(24). Lora narrower than anteclypeus, its inner margin not or only slightly bordered by postclypeus. Posterior seta in pecten of first hind tarsomere regular (Fig. 4E). Anteclypeus parallel sided or often narrowing towards apex; crown-face transition narrowly rounded (Fig. 4C). Pronotum without lateral carina. Color pattern usually consists of longitudinal stripes ..... **Paralimnini**

27'. Lora usually as wide as anteclypeus, 1/3–2/5 of its inner margin bordered by postclypeus (Fig. 4A). Posterior seta in pecten of first hind tarsomere usually platella (Fig. 4D, F). Anteclypeus variable in shape. Pronotum with or without lateral carina. Coloration variable **28**

28(27). Anteclypeus strongly expanded towards apex (at least 1.2 times) ..... **Athysanini**, part

28'. Anteclypeus parallel sided, or if expanded towards apex, less than 1.1 times **29**

29(28). Crown-face transition usually sharp; anteclypeus parallel sided; crown often with impression near rear margin of acrometope; face often flat. Forewing pads often very short (about as long as pterothorax medially). Male gonapophyses usually as long as wide, their apices broadly rounded. Abdomen often with dark setal areolae ..... **Chiasmini**, part

29'. Crown-face transition usually rounded; anteclypeus usually expanded towards apex or, if parallel sided, postclypeus prominent; crown usually without impression near rear margin of acrometope; face usually prominent. Male gonapophyses often longer than wide, with narrowly rounded apices and S-shaped lateral margin. Coloration of abdomen variable.....**Athysanini**, part

Acknowledgements

I am thankful to C. Dietrich, R. Rakitov, J. Zahniser (Illinois Natural History Survey) for providing material for this study. C. Dietrich and two anonymous reviewers provided constructive criticism that greatly improved the manuscript. The work was partially supported by NSF-PEET DEB-9978026 grant.

References

Baker CF (1897) Some new and little known Dorydini (Jassinae). The Canadian Entomologist 29: 157–159.

Ball ED (1902) The genus *Cochlorinus* Uhler and its allies (Jassidae). The Canadian Entomologist 33: 45–51.

Ball ED (1918) The phlepsids of Mexico and Central America (Homoptera, Cicadellinae). Annals of the Entomological Society of America 11: 381–392.

Ball ED (1927) Notes on phlepsids of the subgenus *Phlepsius* (Rhynchota, Homoptera). The Canadian Entomologist 59: 262–265.

Ball ED (1929) A supplemental revision of the genus Athysanus in North America (Homoptera: Cicadellidae). Transactions of the American Entomological Society 55: 1–8.

Barnett DE (1977) A revision of the Nearctic species of the genus *Scaphoideus* (Homoptera: Cicadellidae). Transactions of the American Entomological Society 102: 485–593.

Cwikla PS (1988) A systematic study of leafhopper genus *Chlorotettix* (Homoptera: Cicadellidae). PhD Thesis, Columbus: Ohio State University.

Dallas WS (1870) Rhynchota. Zoological Record 6: 482–499.

DeLong DM (1948) The leafhoppers, or Cicadellidae, of Illinois (Eurymelinae–Balcluthinae). Bulletin of the Illinois Natural History Survey 24(2): 97–376.

Dietrich CH, Dmitriev DA (2003) Reassessment of the leafhopper tribes Koebeliini and Grypotini Haupt (Hemiptera: Cicadellidae). Annals of the Entomological Society of America 96(6): 766–775.

Dmitriev DA (2001) Larvae of some species of the subfamily Eupelicinae (Homoptera: Cicadellidae). Zoosystematica Rossica 2000 9(2): 353–357.

Dmitriev DA (2002c) General morphology of leafhopper nymphs of the subfamily Deltocephalinae (Hemiptera: Cicadellidae). Acta Entomologica Slovenica 10(1): 65–82.

Dmitriev DA (2002d) Larvae of the leafhopper subfamily Deltocephalinae (Homoptera, Cicadellidae) from European part of Russia and adjacent territories. I. A key to tribes and review of the tribes Drabescini, Scaphytopiini, Hecalini, Limotettigini, and Opsiini. Entomologicheskoe Obozrenie 81(3): 627–661. [In Russian; translated into English in Entomological Review 2002(2004) 82(8): 975–100].

Dmitriev DA (2003) Larvae of leafhoppers of the subfamily Deltocephalinae (Homoptera, Cicadellidae) from European Russian and adjacent territories. II. Tribes Grypotini, Selenocephalini, Goniagnathini, Fieberiellini, Tetartostylini, Macrostelini, and Doraturini. Entomologicheskoe Obozrenie 82(3): 650–686. [In Russian; translated into English in Entomological Review 2003(2004) 83(6): 665–695].

Dmitriev DA (2003 onward) Web site: 3I Interactive keys and taxonomic databases. http://ctap.inhs.uiuc.edu/dmitriev/ [accessed 9 VII 2009].

Dmitriev DA (2004a) Nymphs of some species of the tribes Drabescini and Paraboloponini with a proposed synonymy of Paraboloponini with Drabescini (Hemiptera: Cicadellidae: Deltocephalinae). Oriental Insects 38: 235–244.

Dmitriev DA (2004b) Larvae of leafhoppers of the subfamily Deltocephalinae (Homoptera, Cicadellidae) of European Russia and adjacent territories. III. The tribes Deltocephalini, Stirellini, and Paralimnini. Entomologicheskoe Obozrenie 83(1): 87–114. [In Russian; translated into English in Entomological Review 2004 84(1): 31–53].

Dmitriev DA (2006) Larvae of leafhoppers of the subfamily Deltocephalinae (Homoptera, Cicadellidae) of European Russia and adjacent territories. IV. The tribe Athysanini. Entomologicheskoe Obozrenie 85(1): 75–121. [In Russian; translated into English in Entomological Review 2006 86(1): 11–48].

Emeljanov AF (1999) A key to genera of the subfamily Deltocephalinae s.l. (Homoptera, Cicadellidae) from Kazakhstan, Middle Asia, and Mongolia with description of new genera and subgenera. Entomologicheskoe Obozrenie 78(3): 589–609. [In Russian; translated into English in Entomological Review 1999 79(5): 547–562].

Gillette CP, Baker CF (1895) A preliminary list of the Hemiptera of Colorado. Bulletin of the Colorado Agricultural Experiment Station 31: 1–137.

Hamilton KGA (1975) Revision of the genera *Paraphlepsius* Baker and *Pendarus* Ball (Rhynchota: Homoptera: Cicadellidae). Memoirs of the Entomological Society of Canada 96: IV+129 p.

Oman PW (1943) A generic revision of the Nearctic Cicadellidae (Homoptera). George Washington University bulletin 1941–1943: 15–17.

Oman PW (1949) The Nearctic leafhoppers (Homoptera: Cicadellidae). A generic classification and check list. Memoirs of the Entomological Society of Washington 3: 1–253.

Osborn H (1900) The genus *Scaphoideus*. Journal of the Cincinnati Society of Natural History 19: 187–209.

Osborn H (1928) The leafhoppers of Ohio (Cicadellidae). Bulletin of the Ohio Biological Survey 3: 199–374.

Osborn H (1932) Leaf hoppers injurious to cereal and forage crops. Circular of the United States Department of Agriculture 241: 1–34.

Osborn H, Ball ED (1897) Contributions to the hemipterous fauna of Iowa. Proceedings of the Iowa Academy of Science 4: 172–234.

Osborn H, Ball ED (1898d) Studies of North American Jassoidea. A review of the North American species of *Agallia*. Proceedings of the Davenport Academy of Natural Sciences 7: 45–64, pl. 1.

Osborn H, Ball ED (1898e) Studies of North American Jassoidea. Descriptions of early stages and new species of Bythoscopidae. Proceedings of the Davenport Academy of Natural Sciences 7: 64–73, pl. 2–3.

Osborn H, Ball ED (1898f) Studies of North American Jassoidea. New species, dimorphic forms and early stages of Jassidae. Proceedings of the Davenport Academy of Natural Sciences 7: 74–100, pl. 4–6.

Uhler PR (1876) List of Hemiptera of the region west of the Mississippi River, including those collected during the Hayden Exploration of 1873. Bulletin of the United States Geological and Geographical Survey of the Territories 1(5): 269–361.

Uhler PR (1889) New genera and species of American Homoptera. Transactions of the Maryland Academy of Sciences 1: 33–44.

Van Duzee EP (1892) The North American Jassidae allied to *Thamnotettix*. Psyche 5: 305–310.

Van Duzee EP (1916) Suborder Homoptera Latr. 1810. Section Auchenorhyncha A. & S. 1843. Check list of Hemiptera (excepting the Aphididae, Aleurodidae, and Coccidae) of America North of Mexico. 1916: I–XI, 1–111.

Zahniser, JN, Dietrich CH (in press) Phylogeny of the leafhopper subfamily Deltocephalinae (Hemiptera: Cicadellidae) based on molecular and morphological data with a revised family-group classification. Systematic Entomology.